Cruise report for R/V Atlantis Cruises AT-7-15 & AT-7-16
GULF OF ALASKA SEAMOUNT EXPLORATION (GOASEX)

June 22nd – July 15th, 2002
Astoria, Oregon – Kodiak, Alaska – Astoria, Oregon

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Introduction

Goals of the Expedition

The goals of this Ocean Exploration expedition were to explore five previously unexplored volcanic seamounts in the Gulf of Alaska (GOA) to characterize their unique biota and habitats, and to determine how these undersea mountains formed. The deep-sea submersible Alvin was used at each seamount to collect samples and to develop a photographic inventory of benthic macrofauna during each dive. Comparisons were made between seamounts, and depth transects were conducted with the Alvin to examine depth distribution, habitat utilization and community structure of seamount organisms. A full-coverage swath bathymetry map of each seamount was produced, and various rock exposures were sampled for age, duration, composition, and distribution of volcanic phases, as well as for microbiological studies. Reef-building deep-sea corals and sclerosponges were collected to determine their potential for providing information about climate-ecosystem variability in the GOA, and to determine the distribution and reproductive biology of deep-sea corals. The genetic structure of deep-sea gorgonian corals will be studied to determine whether seamount populations are genetically isolated units. Species distribution and habitat utilization of deep-sea crabs were examined and live samples were collected to determine biological characteristics such as species, sex, and reproductive condition. A 'gentler' manipulator claw was developed and tested on the Alvin to aid in the collection of live crabs. Observations were made at various depth ranges where particular crab species were most abundant, to document reproductive or aggregative behaviors, as well as biological interactions with other species.

Anticipated benefits

Most seamounts in the Gulf of Alaska have never been explored, so there was great potential for new discoveries during this expedition. Because of their isolation, seamounts are known for high levels of endemism. Not surprisingly, a large percentage of seamount fauna has been found to be endemic in other regions of the world's oceans. We anticipated that the GOA seamounts will prove to be as biologically rich as others, and so ultimately the results of this expedition would have profound implications to aid in the protection of seamount fauna in the GOA. Other benefits of this expedition included gaining a more complete understanding of the geologic history of the GOA, and potentially adding to our current knowledge of historic climate and oceanic conditions of this dynamic region. Through our work we will also determine the importance of seamounts as essential habitats for unique and likely endemic species.

Education and Outreach

This expedition provided a wonderful educational opportunity to inform and excite the general public, as well as the scientific community, about unique and unexplored regions of the deep ocean environment. Outreach and education products included detailed lesson plans that target grades 5-12. Undergraduate and graduate students participated in the cruise, and will also benefit through post-cruise presentations by cruise participants at their respective institutions. An Alaskan native undergraduate student from the University of Alaska participated in the cruise, as did a K-12 educator. The student and teacher assisted with the collection of material for the NOAA oceanexplorer.noaa.gov website, through which the general public was targeted. A team of professional videographers were present on the northbound leg of the cruise with the goal of developing an expedition video that will target a general audience.

A scheduled port stop in Kodiak, AK, provided an opportunity for invited students, teachers, fishing and conservation representatives, elected officials, and other invited guests to come aboard the RV Atlantis and view Alvin and the science made possible by this expedition.

GOALS AND OBJECTIVES OF EACH RESEARCH TEAM

Geology and Microbiology

Our goal is to understand the volcanic and tectonic histories of seamounts in the Gulf of Alaska, and thus expand our knowledge of the geologic history of the Gulf. In order to understand how the Gulf of Alaska seamounts formed and for how long they were volcanically active, we planned to visit five previously unexplored seamounts (Figure 1), create full-coverage swath bathymetry maps of them and their surroundings, and collect rock samples to determine their volcanic histories. In addition to the importance of these seamounts as geologic records of volcanic activity in the Gulf of Alaska and the dynamics and kinematics of the Northeast Pacific Basin, they are significant for their influence on oceanographic circulation, and also serve as centers of biological activity. Our explorations also included a search for new microorganisms living in the rocks. The frontiers of microbial research are expanding rapidly, largely as a result of the search for microorganisms with medical and industrial applications.

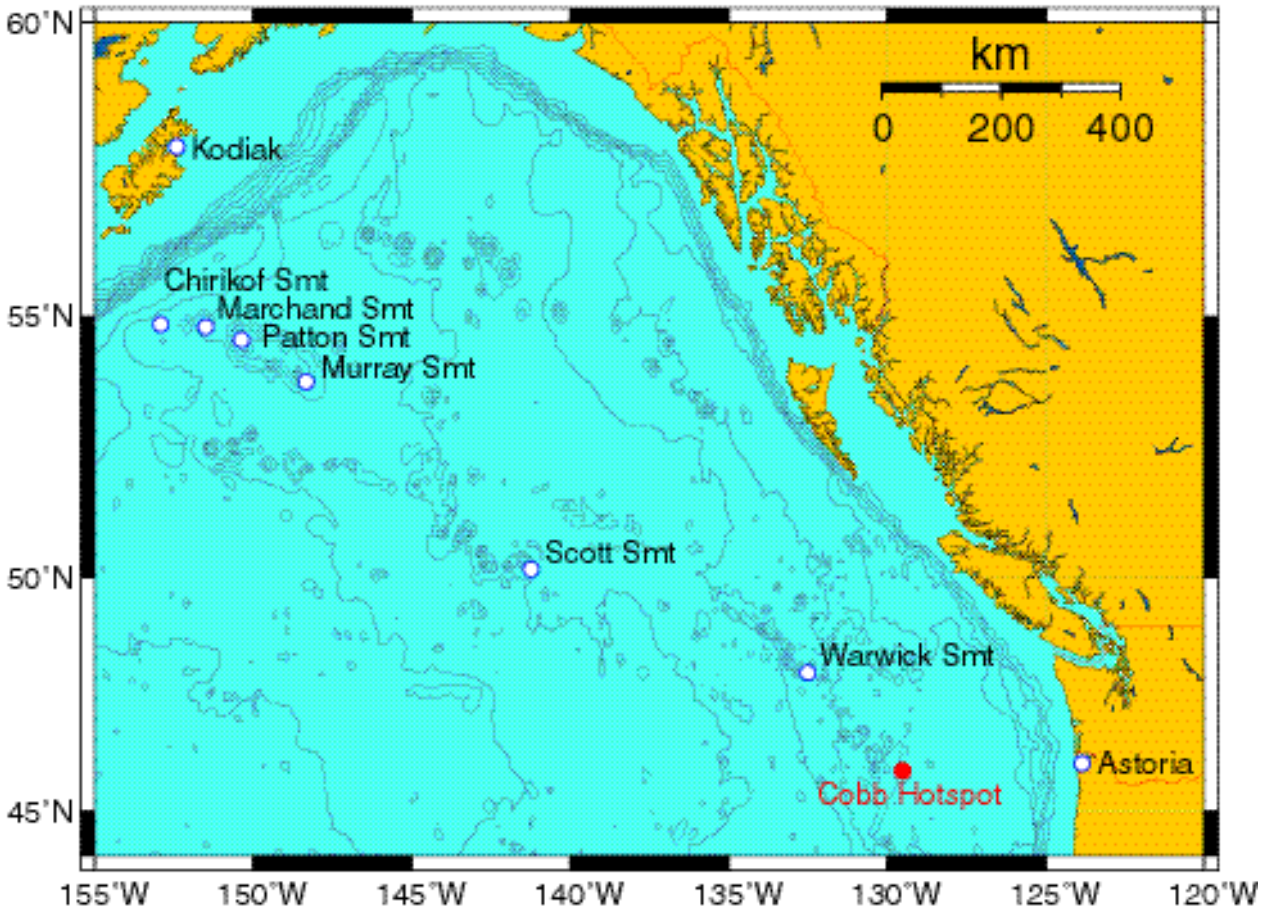

Figure 1. Map of the Gulf of Alaska showing the locations of the six seamounts visited on this expedition. Scott Seamount was mapped, but not sampled. The current location of the Cobb hotspot under Axial Seamount on the Juan de Fuca Ridge is also shown because all of these seamounts (except for Scott) probably formed at the Cobb hotspot.

Our approach was to create a full-coverage swath bathymetry map of each seamount and collect rock samples along vertical transects through the maximum possible depth intervals, with the objectives to establish the:

• Volcanic history of Murray Seamount. Are there undiscovered rift zones or summit cones on Murray that are the source of the anomalously young basalts known to exist nearby?

• Volcanic history of Warwick Seamount. This seamount formed above a hotspot, but close to a spreading center. How does its volcanic history reflect the interplay of the hotspot and the ridge, especially in comparison to the younger and older seamounts in the same hotspot trail?
• Age and plate tectonic setting of Chirikof and Marchand seamounts. What are the ages and origins of these two seamounts? Are they the oldest remaining products of the Cobb hotspot, or do they have some other origin?
• Microbiology of progressively older seamounts in the Cobb hotspot trail. How quickly does microbial alteration of basalts progress, and under what conditions?

Each of these seamounts could stand alone as an exploration target, but the synergy of studying them all together provides comparisons between seamounts formed over the same hotspot but at different times and distances from a seafloor spreading center. In addition, we can extend our comparison to the substantial body of published data from the current location of the Cobb hotspot beneath Axial Seamount on the Juan de Fuca Ridge.

Crabs and Associated Invertebrates

Knowledge of the biology of deepwater crab and other invertebrate species on seamounts is poor, but is essential to obtain before fishing alters them irrevocably. Crab populations at seamount sites are presently under- or unexploited. Our goals in 2002 were to use the information from a previous exploration of Patton Seamount in 1999 to focus on the biology and habitat use of 5 species of deepwater crabs: the golden king crab, *Lithodes aequispinus*, the scarlet king crab, *L. couesi*, the grooved Tanner crab, *Chionoecetes tanneri*, the triangle Tanner crab, *C. angulatus*, and the large-clawed spider crab, *Macroregonia macrochira*. Particular emphasis was placed on the biology of *Lithodes aequispinus* because of its high commercial value and intriguing questions concerning changes in bathymetric distribution with ontogeny.

Our objectives were to visit the depth range in which crabs (particularly juveniles and mature females) are most abundant, document the habitat characteristics by species, sex, and reproductive condition, and observe any reproductive, nocturnal, or aggregative behavior, and biological interactions with other species. Specimens of each crab species were captured to determine their reproductive status. Samples of habitat types, and representative organisms from the surrounding benthic community were collected for examination. This study should provide basic information on biology, ecology, habitat, and behavior for crab species about which little is currently known. An additional objective was to identify other invertebrate and fish species observed on the seamount, and document their depth distribution and community structure. These data could be used for comparison to later surveys on other seamounts; because of their uniqueness, seamounts may be good candidates for Marine Protected Areas.

Specific Objectives and questions:

Adult depth range: Observe and document depth ranges of adult crabs (particularly mature females) principally of *L. aequispina* and *L. couesi*, *C. tanneri* and *C. angulatus*. Determine if males and females occur at similar depth, and if they are segregated by sex.

Habitats and species interactions: Examine and describe the habitats where each species occurs. Determine which species are sympatric and whether they occupy the same habitat.

Juvenile depth range and habitats: Locate juvenile crabs and describe their depth range and habitats/substrates. Collect and examine potential habitats for juveniles, such as: hydroid colonies, coral colonies, and other sessile colonial invertebrates.

Study reproductive condition of female crabs. Capture and examine females in order to determine their stage of larval and ovarian development. Females of some species may be asynchronous spawners, so different crabs may be in different reproductive phases.

Capture and Holding Conditions: Use a “kinder, gentler” manipulator for capturing crabs with less damage. Maintain collected crabs in chilled sea water tanks aboard the *Atlantis.*

Diversity and community structure other species. We hope to compare the invertebrate communities between the seamounts we visit on this cruise. Begin to assemble a picture of the biogeography of GOA Seamounts.

Carbon Cycle and Climate Change

To study changes in ocean circulation and water mass distribution involved in the genesis and evolution decadal climate variability, it is necessary to have records of climate variables several decades in length. Instrumental records are limited because technology for continuous monitoring of ocean currents (*e.g*. satellites and moored arrays) has only recently been available. The historical record of key physical (eg. SST, SLP, salinity) and corresponding environmental (eg. nutrients, phyto-zooplankton standing stocks, fish-catch/recruitment) variables is of insufficient length and contains spatial and temporal gaps such that we have an incomplete picture of the nature of decadal scale variability. Long time-series data is required to test the various hypotheses regarding the ultimate cause of decadal scale variability and increase the reliability of our prognostication of future climate The close correspondence between ecosystems and climate or ocean conditions in the Gulf of Alaska provides a natural laboratory to explore biogeochemical archives in deep-sea corals and sclerosponges in the context of extending our observations back beyond the instrumental record.

Our objectives for this cruise follow this theme with three primary themes: determine the amount of anthropogenic (fossil fuel) CO_2 in the region utilizing Suess effect driven changes in $\delta^{13}C$ and bomb-radiocarbon. Reconstruct the decadal – centennial scale oceanic variability in the Alaskan Gyre via biogeochemical proxy records in deep-sea corals (scleractinian) and gorgonians. Reconstruct the longer or millenial scale (glacial-interglacial) variability as recorded in sediment geochemistry and biological archives (eg. planktonic and benthic foraminifera).

In addition we will assess the longevity of deep-sea corals. Deep-sea macro fauna are not only interesting in their own right but provide habitat for an uncountable number of individuals/species including commercially important species (eg. rockfish, cod, halibut, king crabs). These mini-reefs are threatened by human activities such as trawling and long-lining. There is also a mitigation strategy being developed as part of the national energy policy whereby anthropogenic CO_2 will be directly injected into the deep-ocean (termed ocean carbon sequestration). It is unclear what effect this activity may have on deep-sea ecosystems via alteration of interior water carbon chemistry.

Sampling strategy:

1. Anthropogenic CO_2 in the North Pacific
    a. Underway and CTD stations where we will measure
        i. ΣCO_2
        ii. $\delta^{13}C$, $\Delta^{14}C$ of dissolved inorganic carbon
2. Nutrient cycling and oceanic biogeochemistry
    a. Underway and CTD stations where we will measure
        i. $\delta^{13}C$ and $\delta^{15}N$ of particulate organic carbon
    b. Collection of push cores with sediment/water interface intact.
3. Collection of deep-sea corals: stony (scleractinian) and gorgonians
    a. Distribution of deep-sea corals and relation to depth, T, S, $[O_2]$
    b. Distribution of deep-sea corals in the North Pacific
4. Gravity coring
    a. Bathymetric mapping and sub-bottom profiling of a number of potential targets in the time available.
    b. Collection of giant gravity cores from suitable locations.

RESULTS

Navigation

Atlantis cruise 7-15 departed Astoria, Oregon at 0800 on June 22nd, 2002, and ended in Kodiak, Alaska at 0900 on July 3rd, 2002. Atlantis cruise 7-16 departed Kodiak, Alaska at 0930 on July 4th, 2002, and ended in Astoria, Oregon at 1300 on July 15th, 2002. The first 4 days of the northbound leg were spent in transit to Murray Seamount. We arrived on site in the early hours of June 26th, and conducted a short SeaBeam survey before the first dive on the morning of the 26th. The work pattern thereafter consisted of Alvin dives during the day and SeaBeam surveys, CTDs, and gravity coring at night. Six additional dives were conducted on Murray, Patton, and Chirikof seamounts, before departing the study area at 1700 on July 2nd for the transit to Kodiak. After an overnight transit from Kodiak to Marchand Seamount we conducted the first dive of the southbound leg on Marchand, followed by an overnight transit to and dive on Murray Seamount. We then departed Murray on July 6th for the 30 hour transit to Campbell and Scott seamounts. After passing over Campbell and Scott and determining that the top of Scott was shallower we prepared to dive on Scott, but 20 knot winds and a building swell caused the dive to be postponed and then canceled. We decided to abandon Scott because the top was about 1000m deep and spend the last four dives on Warwick Seamount, whose top comes up to about 500m. After another 30 hour transit, we arrived at Warwick and commenced SeaBeaming, Alvin diving, CTDing, and gravity coring until we departed for Astoria at 2300 on July 13th.

Acoustic Surveys

We conducted complete SeaBeam surveys of each seamount and its surroundings to select dive and gravity core locations and to search for structural and tectonic lineations that could provide clues to how these mountains formed. We obtained full-coverage bathymetry maps of all of the seamounts visited except for Patton, where a map already existed from our 1999 Atlantis cruise.

Dives

On the northbound leg (AT-7-15), seven dives were completed (Table 1), with no dives lost to weather. After the first three dives on Murray Seamount, we determined that the top was too deep to meet our goals of observing Golden king crabs, so the next three dives were made on Patton Seamount. This caused incomplete sampling of geology and coral on Murray seamount, but another dive was scheduled there for the second leg. The final dive of the first leg was on Chirikof Seamount.

On the southbound leg (AT-7-16), six dives on three seamounts included a dive on Marchand Seamount, followed by our fourth dive on Murray Seamount. A dive scheduled for Scott Seamount was canceled due to weather. The final four dives were on Warwick Seamount.

Geology and Microbiology

Geologists participated in 8 of the dives, and at least one good rock samples was recovered on all of the dives except for the 3 on Patton (Table 2), where there is already a good collection of rocks from the 1999 Alvin dives there. Glacial erratics and manganese crusts were a problem on all of the seamounts except Warwick.

Rocks were collected on five dives for microbiological studies (Table 3). The Alvin manipulator placed the rocks in an isolation box which is designed to minimize contamination of the rocks with surface water and to hold the rocks in their ambient sea water until they are transferred to sterile containers on deck. Microorganisms were filtered from the water in the isolation box to collect microorganisms for a control.

Rocks were subsampled and processed in a clean hood in the Atlantis Biology Lab. Subsamples were frozen at -80°C for later extraction of DNA. Whole rock subsamples were preserved for examination by scanning electron microscope (SEM) and for attached prokaryotic abundance (APA). Crushed subsamples were used to inoculate cultures that contained sterile basalt glass, and crushed

material was also preserved to determine detached prokaryotic abundance (DPA). These analyses will be completed at laboratories at Oregon State University. Analyses of phospholipid fatty acids (PFLA) will be conducted at a lab in Denmark.

These future analyses will tell us the amount and kinds of bacteria that live within deep sea volcanic rocks. Microbes in these deep sea rocky environments may be some of the most primitive on Earth because of their potential ability to survive on a diet of rocks and water. Microbes with this ability could have lived before the appearance of plants about 3,800 million years ago.

Table 1. Dive Summary

Date	Dive	Location	Latitude (N)	Longitude (W)	Dive Time	Bottom Time	Start Depth	Objectives	Port Scientist	Starboard Scientist
6/22/02		Depart Astoria						Safety drill, science mtg		
6/23/02		In transit						Alvin briefings		
6/24/02		In transit								
6/25/02		In transit								
6/26/02	3797	Murray Smt	53° 53.47'	148° 30.66'	8:29	4:19	2763	rocks & crabs	Keller	Stevens
6/27/02	3798	Murray Smt	53° 53.56'	148° 31.93'	6:44	5:45	1089	crabs & rocks	Shirley	Rowe
6/28/02	3799	Murray Smt	53° 59.54'	148° 30.23'	5:56	4:48	1358	coral & crabs	Guilderson	Nielsen
6/29/02	3800	Patton Smt	54° 36.0'	150° 26.54'	5:42	5:17	485	crabs & coral	Shirley	Roark
6/30/02	3801	Patton Smt	54° 33.94'	150° 23.03'	7:17	6:25	1035	crabs & PR	Stevens	Cohen
7/1/02	3802	Patton Smt	54° 31.83'	150° 18.21'	5:51	3:51	2052	crabs & PIT	Heyl	Berry (PIT)
7/2/02	3803	Chirikof Smt	54° 49.51'	152° 55.73'	8:38	5.23	3222	rocks & coral	Keller	Baco
7/3/02		Arrive Kodiak						Port Call and PR/Outreach		
7/4/02		Depart Kodiak						Transit to Marchand Smt		
7/5/02	3804	Marchand Smt	54° 56.83'	151° 19.19'	8:38	5:29	3038	rocks & coral	Rowe	Flood Page
7/6/02	3805	Murray Smt	57° 1.19'	148° 31.05'	6:28	4:27	1993	coral & rocks	Moy	Fisk
7/7/02		Transit								
7/8/02		Scott Smt	Dive canceled due to rough seas							
7/9/02		Transit								
7/10/02	3806	Warwick Smt	48° 5.35'	132° 50.63'	5:58	4:52	842	coral & crabs	Dunbar	Hoyt
7/11/02	3807	Warwick Smt	48° 4.89'	132° 39.46'	6:54	4:24	2573	rocks & PIT	Fisk	Leach (PIT)
7/12/02	3808	Warwick Smt	48° 3.32'	132° 44.62'	6:37	5:52	758	coral & rocks	Guilderson	Russo
7/13/02	3809	Warwick Smt	48° 5.47'	132° 44.78'	5:12	4:02	1191	coral & rocks	Roark	Russo
7/14/02		Transit								
7/15/02		Arrive Astoria								

Table 2. Rock Recovery

Dive	Seamount	Rocks	Mass (kg)	Lithologies
3797	Murray	8	45	4 basalts, 1 breccia, 1 Mn crust, 2 erratics
3798	Murray	3	14	all breccias
3799	Murray	4	3	1 breccia, 3 erratics
3800	Patton	0		
3801	Patton	1	4	Mn crust
3802	Patton	0		
3803	Chirikof	9	18	7 basalts, 1 hyaloclastite, 1 erratic
3804	Marchand	7	21	5 basalts, 1 breccia, 1 Mn crust
3805	Murray	7	16	6 basalts, 1 erratic
3806	Warwick	1	7	basalt
3807	Warwick	10	44	8 basalts, 2 hyaloclastites
3808	Warwick	5	30	all basalts
3809	Warwick	4	40	all basalts

All samples are curated at COAS, Oregon State University

Table 3. Rock Samples for Microbiology Studies

Sample	Description	Depth (m)	Latitude (N)	Longitude (W)	Samples prepared Cultures	SEM	DNA	APA	DPA	Other
3803-3	hyaloclastite	3170	54° 49.48'	152° 55.67'						Frozen for later study
3804-5	basalt	2459	54° 56.34'	151° 19.48'	yes	yes	yes	yes	yes	DNA of bottom water
3805-1	water	1985	54° 1.18'	148° 30.15'	yes				yes	DNA of bottom water
3806-1	basalt	815	48° 5.41'	132° 50.42'	yes	yes	yes	yes	yes	DNA of bottom water
3807-1	hyaloclastite	2468	48° 4.90'	132° 39.58'	no	yes	yes	yes	yes	DNA of bottom water
3807-2	hyaloclastite	2288	48° 4.81'	132° 39.87'	yes			yes	yes	DNA of bottom water
3807-5	basalt	2028	48° 4.67'	132° 40.24'	yes	yes	yes	yes	yes	refrigerated samples for PFLA
3809-3	basalt	1148	48° 5.25'	132° 44.86'	yes	yes	yes	yes	yes	DNA of bottom water

Crabs and Associated Invertebrates

A total of 67 crab specimens belonging to 9 species were collected from five seamounts. Morphological measurements, carapace condition, and correlates of reproductive status were recorded for these specimens (Table 4). Gonads and embryos were collected when available from female specimens; photo documentation of gonad color and development was made. Many specimens were returned alive to the NMFS laboratory at the end of leg AT-7-15 for culturing and continued studies of their biology. Additional specimens were returned frozen or preserved from cruise leg AT-7-16. For all specimens not retained alive, tissue samples were collected for Dr. Amy Baco (WHOI) for genetic analyses. Additional tissue samples were collected for determination of nutritional sources by means of carbon isotope analyses, to be conducted by Dr. Sathy Nadiu, University of Alaska Fairbanks.

Determinations of depth distributions and habitat associations of adult crabs (principally of *M. macrochira, L. aequispinus* and *L. couesi*, *C. tanneri* and *C. angulatus*) will be made from video tapes collected from the 13 Alvin dives. Most species had heterogeneous distributions, either bathymetrically or spatially; habitat types and faunal assemblages appeared to be involved with the distributional patterns of crab species. Our preliminary observations suggest that juveniles of *L. aequispinus* and *L. couesi* were confined to a narrow bathymetric range at depths deeper than those in which the adults are normally encountered. *Macroregonia macrochira* were ubiquitous at all deeper dive sites (e.g., >1000 m). A significant portion of *M. macrochira* specimens observed in situ were missing appendages, suggesting evidence of predation or agonistic interactions. The lack of regenerating appendages among specimens suggested molting of adults did not occur or was infrequent. Mating or fighting scars were present on the appendages of adult male specimens; one large male was recorded eating an adult female. Feeding or attempting feeding activities of many specimens was recorded on video. Commensal amphipods were collected from two specimens, at depths deeper than previously recorded.

The top of Murray seamount lies at approximately 700 meters depth. *L. couesi, M. macrochira, C. angulatus, Chirostylus sp., Paralomis verillii,* and *P. multispina* were collected there, but no *L. aequispina* were observed (see Table 1). For this reason, we moved to Patton Seamount for the next dives. There, all the above species, plus *L. aequispina, Oregonia bifurca, Munida sp.,* and *C. tanneri,* were observed and/or captured. Of these species, all except for *Munida sp.* had been captured on Patton Seamount in 1999.

Our major goal was to locate and describe the habitat of juvenile of La (see Table 5 for abbreviations) and Lc. This did not become apparent until dive 3801 on Patton Seamount. On that dive, we observed that juveniles of Lc occurred from 550 to 900 m, but that La only occurred in a narrow band from 583 to 623 m. Virtually all juvenile lithodes occurred either on solid rock on or cobble and boulders. They were rarely observed on sand/gravel bottom. Yellow crinoids were abundant from 583 m to the top of Patton Seamount (<300 m), and no juvenile La were observed among them in those depth zones.

Table 4. Crab Measurements

ID	Species	Sex	Dive	Meters	CL	CW	PH	PL	Shell	Notes	Repro	Ovary	Sptheca
	M. macrocheira	M	3805	1300	102.3	87.9	13.5	73.4	3	ML5			
	C. tanneri	M	3806		100.9	116.0	30	50.3	4	DL1,DL2, CB			
	C. tanneri	F	3806		76.6	95.3	17.4	28.5	2			orange, full, partly extruded	
	Galatheid	F	3806		41.6	32.6			2	ND	Large yellow eggs		
	Galatheid	F	3806		29.1	19.9			2	ND	Full clutch, sharp, clean, yellow eggs		
	M. macrocheira	M	EL3807	2600	77.9	67.2	11.2	49	2	ND			
1914	M. macrocheira	F	EL3807	2600	93.9	83.3	13.1	32.3	2	caprellids-mandibles not max. eggs washed out?	No eggs?	peach	MT
1960	M. macrocheira	F	EL3807	2600	93	83.4	13.1	38.2	2	ML4, caprellid on carapace	No eggs?	Pale peach	flacid
1909	M. macrocheira	F	EL3807	2600	75.3	68.0	10.5	31.9	3	MR1	No eggs?	Light orange	flacid
	P.multispina	M	3809	950	95	102.0	29.6	45.4	1	ND			
	M. macrocheira	M	3809	1200	122.3	108.1	24.9	150.4	4	ND, mating scars, CB			
	C. tanneri	M	3809	1200	96.7	117.2			4	Lots of scars,CB			
	L. couesi	M	3809	1200	90.8	95.1	17.2	29.4	2	ND			
	L. couesi	M	3809	1200	122.7	132.2	20.4	35.9	3	ND			
	C. tanneri	M	EL3809	1200	118.8	99.0	23.1	50.4	3	chitinoclastic bacteria			

Table 5. Crab species captured on each dive.

	species							
Dive	Ca	Ch	La	Lc	Mm	Pm	Pv	Grand Total
3798		2		3	1			6
3799				3	1	1	1	6
3800			11	2				13
3801			2	1				3
3802	3				19		2	24
3803					1			1
Grand Total	3	2	13	9	22	1	3	53

Abbreviations are: Ca, *C. angulatu;* Ch, *Chirostylus sp;* La, *Lithodes aequispinus*; Lc, *Lithodes couesi;* Mm, *M. macrochira;* Pm, *P. multispina*; Pv, *Paralomis verillii.*

The pattern of zonation that appears is that the largest specimens of La occur on rock pinnacles from 250-400 m. Juveniles apparently settle in the deeper water below 600 m. The presence of dense fields of crinoids between 400 and 600 m probably prevents successful settlement of juvenile king crabs in their depth zone. Crabs probably have to grow to a size at which they are no longer vulnerable to crinoid predation before they can navigate their way back upslope to shallower depths. Lc remain at deeper depths as adults, perhaps due to competition from the much larger La.

Of particular interest to us were the spider crabs, Mm. Their biology is virtually unknown, yet they are fairly abundant below 1000 m, and the only brachyuran at those depths. We captured 22 specimens either with Alvin's manipulators, or using a baited trap on the elevator. Most did not survive the trip to the surface, despite being placed in a tank of chilled seawater. Many females were dissected for examination of ovaries. Ovary conditions varied from undeveloped and unspawned, to partly developed and ovigerous, to well developed. This suggests that spawning is asynchronous in this species. Samples were also provided to Amy Baco (for Tim Shank) for studies of population genetics. This crab species is widespread throughout the North Pacific deep water, so may prove to be an excellent candidate for such research.

We brought two new tools with us. A large basket with plastic fingers worked exceptionally well for holding large crabs on Alvin's science tray, although smaller specimens sometimes washed out or escaped. The "crabulator", a set of metal fingers for the starboard manipulator did not work as well as hoped, but provided experience for future design modifications. We also built a second "trap" that was placed on the elevator, and was used successfully to capture spider crabs.

Observations of crabs and other invertebrates were recorded on videotape. Some species were not present on both Patton and Murray seamounts. This may be partly the result of depth differences, but some species (eg. The mushroom coral, Anthomastis) were absent even at similar depth zones. Occasional observations of other species were intriguing. During one dive, Alvin was surrounded by flying squid that zoomed past the sub, and some watched carefully, or followed the movements of Alvin's manipulators as they captured samples. Others were seen lying on the substrate. A detailed examination of the videotapes should provide much more valuable information.

A summary of samples taken for genetic studies by Amy Baco-Taylor is given in Table 6.

Table 6. Summary of samples for genetic studies.

	Murray	Patton	Chirikof	Marchand	Warwick
Bamboo spp.	5	11	3		8
Primnoid sp. 1 "white pipe cleaner"	3	3	1		
Primnoid sp. 2	3		1	6	4
Antipatharian spp.	6	1	1		
Paragorgia	2+1?				1
Rubbery Pink	3				1
Other Corals	2	2	1	1	2
Ophiuroid spp.	48+	76+			30+
Polychaetes	2				
Lithodes couesi	1	1			2
Macroregonia macrocheira	2	4	1		5
Chionocetes tanneri					3

Carbon Cycle and Climate Change

Underway sampling was performed on the outbound leg (Astoria – Kodiak) at approximately every half degree of latitude. CTD stations were determined to provide baseline hydrographic information for relation to the distribution of deep-sea macrofauna, and carbon-chemistry. Particulate organic carbon was collected for all underway samples and a sub-set of Niskin bottles from the CTDs.

In the course of this research cruise we participated in 13 Alvin dives. On the first leg, we collected a small number of individuals. A complete listing of the coral collection can be found in the individual dive plan reports. Key samples include: one small living and two sub-fossil bamboo corals, and a large *Paragorgia* from Murray Seamount. On the second leg, we collected a number of living bamboo corals, and a single large *Paragorgia* from Warwick Seamount. Other small living specimens were collected to understand feeding behavior.

Night operations included swath-mapping (sea-beam) bathymetric surveys. These surveys were used to select a small sub-set of saddles, channels, and perched basins for subsequent sub-bottom profiling and assessment of coring. On the first leg, we obtained one short GGC (giant gravity core) at Murray Seamount. No other suitable sites were found, although a more intensive and detailed survey could prove fruitful. A similar strategy was employed on the second leg and six GGCs were taken at depth on the flanks of Warwick Seamount including two cores in excess of fourteen feet in length.

Education and Outreach

SUMMARY

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APPENDIX A. DIVE DATA

Dive plan for	Alvin Dive #	**3797**				
Date	6/26/02	Wednesday				
Time	Start Dive	8:00				
	End Dive	17:00				
Location	Murray Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		2700 m	53	53.63	148	30.38
End Position		2190 m	53	54.38	148	30.71
Distance	naut. Mi.	0.785				
	Heading (true)	346				
Personnel	Pilot	Bruce Strickrott				
	Port Observer	Randy Keller	Lead Scientist			
	Stbd Observer	Brad Stevens	Scientist			

Objectives
- Exploration, bottom to top if possible
- Collect rocks in sample basket
- Look for crab species present
- Look for coral; collect if possible
- Other inverts
- Push cores at deepest point
- Water sample at deepest point

Special Equipment
- Rock Basket
- wood Biobox
- Push cores
- Niskin bottle (1)

Samples collected
- 8 rocks (5 volcanic, 2 erratics, 1 Mn crust)
- 3 sediment cores
- 1 sponge
- several corals

Sample data		Zulu Time	m Depth	X	Y
Sediment core 1	left outside	19:15	2727	5064	6750
Coral 1	white, branched, 2 pieces	19:45	2680		
Sediment core 2,3	left inside, right inside	21:17	2388	5004	7522
coral 2	"pipe cleaner", large	22:24	2254	4776	7957
coral skeleton		23:06	2188	4705	8118

Dive plan for	Alvin Dive #		**3798**			
Date	6/27/02	Thursday				
Time	Start Dive		8:00			
	End Dive	1440 on bottom		1530 on deck		
Location	Murray Seamount					

	Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position	1094	53	56.00	148	32.50
End Position	670	53	57.10	148	33.00

Distance naut. Mi.

Personnel	Pilot	Phil Forte	
	Port Observer	Tom Shirley	Lead Scientist
	Stbd Observer	Mike Rowe	Scientist

Objectives
Collect crabs in basket
Collect rocks in basket
Collect corals
Push cores at deepest point
Water samples at deepest point

Special Equipment
Crab basket
"Crabulator fingers"
Small rock basket
Coral box
Push cores
Niskin bottles (5)

Samples collected		Number	Zulu time	Depth	X	Y
Scarlet king crab	Lithodes couesi	3				
red pinchbug	Chirostylus sp.	2		760		
spider crabs	Macroregonia macrochira	1				
Sediment cores		3	2035	936	2656	12308
Niskin water samples		5	2156	718		

3 rocks (all volcanic)

Dive plan for	Alvin Dive #		**3799**			
Date	6/28/02	Friday				
Time	Start Dive		8:17			
	End Dive	13:47 on bottom				
Location	Murray Seamount					

	Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position	1407	53	59.58	148	30.48
End Position	649	53	58.83	148	30.48

Personnel	Pilot	Pat Hickey
	Port Observer	Tom Guilderson
	Stbd Observer	Julie Nielsen

Objectives
Main coral collection dive on Murray
video archive factors determining crab distribution:
substrate, depth, coral cover, etc
niskins and pushcores where possible
collect crabs

Special Equipment
Coral/Rock box
Push cores
Niskin bottles (5)

Samples collected

4 rocks (1 volcanic, 3 erratics)

Scarlet king crab	Lithodes couesi	3
	Paralomis verillii	1
	Paralomis multispina	1
spider crabs	Macroregonia macrochira	1
Kamchatka coral	Paragorgia arborea	1
Bamboo coral		3
Antipatharian coral		several
basket stars	Gorgonocephalus sp	dozens

OBSERVER NOTES:
On bottom 1709h, 1404 m water Z
Large spider crab dead ahead -
Brittle stars everywhere
Large branching coral to port that we overshot as we came in for landing.
In hindsight possibly a bamboo coral and one that we would have loved to have.
2 niskins fired #1 and #2 for N.W.
Spider crab volunteered for pot.

Spotted in X: 4920, Y 18067 - 300 m from orig projected dive location, but flew to approp contour.
First coral specimen in Baco bin #1: 4920 18050 2.4°C
1400m
Rock sample 1404m X: 4916, Y: 18048 turned out to be an erratic
Second specimen for AB bin #4: X: 4931, Y: 17954 2.4°C
Third specimen for AB bin#5: X 4956 17857, 2.4°C 1376m Time stamp: 18:08:29
Two large corals in crab basket: 4964 17731, 2.4°C 1337m
bamboo coral attached to rock, and yellow branching coral
Fourth specimen for AB bin#6 X 4954 Y 17652 1308m Time stamp: 18:31:28
Rocky outcrop/ledge @ 1230m Time stamp: 18:51:32

nominal: 4956, 17491 (18:56 - 19:11)

Sampled coral @ this ledge -
one live coral -black coral (sea fan/fern) into crab basket: additional specimens into Baco bins 7, 8, 9
fired niskins 3&4 for NW
Sub-fossil bamboo - can see where it broke off: 4975 17065 932m Time stamp: 19:52
other small bamboos - polyps fully extended, not worth taking - too small.
Another fossil bamboo into crab pot: 4991 16946 838m Time stamp: 20:21
This one was in situ - standing upright and attached
coral sample: 4988 16887 800m, Time stamp: 20:27
Paragorgia spp all over the place 720 - 680m
Paragorgia "felled" 5015 16774, 722m Time stamp: 20:37
Last niskin 4989 16505 664m Time stamp: 21:35h

Dive plan for	Alvin Dive #	**3800**				
Date	6/29/02	Saturday				
Time	Start Dive	7:55				
	End Dive	13:22				
Location	Patton Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		484	54	36.00	150	27.00
End Position		274	54	35.00	150	27.00
Distance	naut. Mi.	1				
Personnel	Pilot	Bruce Strickrott				
	Port Observer	Tom Shirley				
	Stbd Observer	Brendan Roark				
Objectives	Golden king crabs + juvenile					
	Collect corals					
	niskins and pushcores where possible					
Special Equipment	Crab basket					
	Coral/Rock box					
	Push cores					
	Niskin bottles (5)					
	Crabulator					
Samples collected	1 mating pair of Lithodes couesi					
	1 mating pair of Lithodes aequispinus					
	9 additional male Lithodes aequispinus					
	6 samples of soft coral	for Amy Baco				
	5 Niskin bottles					
	1 bamboo coral					
	1 Brisingid starfish					

Dive plan for	Alvin Dive #		**3801**			
Date	6/30/02	Sunday				
Time	Start Dive		8:00			
	End Dive		16:00			
Location	Patton Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		1023	54	33.85	150	23.10
End Position		325	54	33.90	150	25.60
Distance	Range		0.85 n. mi.			
	Bearing		270 TRUE			
Personnel	Pilot	Phil				
	Port Observer	Brad Stevens				
	Stbd Observer	Chad Cohen				
Objectives	Golden king crabs and juveniles					
	Collect corals					
	niskins and pushcores where possible					
	Live broadcast from the bottom					
Special Equipment	Crab basket					
	Coral/Rock box					
	Push cores					
	Niskin bottles (5)					
	Crabulator					
Samples collected	L. aequispina	2, grasping				
	L. couesi	1				
	Coral samples	5				
	Water samples	3				
	1 rock (Mn crust)					

Dive plan for	Alvin Dive #		**3802**			
Date	7/1/02	Monday				
Time	Start Dive		8:00			
	End Dive		0:00			
Location	Patton Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		2052	54	31.69	150	18.17
End Position		1615				
Distance	Range		0.85 n. mi.			
	Bearing		270	TRUE		
Personnel	Pilot	Pat Hickey				
	Port Observer	Taylor Heyl				
	Stbd Observer	PIT - Anthony Berry				

Objectives

Locate crab elevator
Golden king crabs + juveniles
Collect mature females if possible
Collect corals
niskins and pushcores where possible
Go deep or go home

Special Equipment

Crab basket
Coral/Rock box
Push cores
Niskin bottles (5)
Crabulator

Collections

Located crab elevator and released to surface with 14 crabs
2 push core samples
2 niskin water samples
6 coral samples
2 Paralomis verillii
22 C ang macroregonia

Dive plan for	Alvin Dive #	**3803**				
Date	7/2/02	Tuesday				
Time	Start Dive	8:00				
	End Dive	17:00				
Location	Chirikof Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		3300	54	49.48	152	55.67
End Position		2660	54	50.44	152	55.84
Distance	1.5 km					
Personnel	Pilot	Bruce Strickrott				
	Port Observer	Randy Keller				
	Stbd Observer	Amy Baco				
Objectives	Collect rocks Collect corals niskins and pushcores where possible crabs if seen					
Special Equipment	1 extra long milk crate for corals 2 long milk crates for rocks 2 small milk crates for rocks Niskin bottles (5) Push cores					
Samples collected	9 rocks (all volcanic)					

Dive plan for	Alvin Dive #	**3804**				
Date	7/5/02	Friday				
Time	Start Dive	8:00				
	End Dive	5:00				
Location	Marchand Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		3038				
End Position		2163				
Distance	Range	2.9 km				
Personnel	Pilot	Phil Forte				
	Port Observer	Michael Rowe				
	Stbd Observer	Sarah Flood Page				

Objectives

Collect frocs from many depths for geology
Collect 7-8 rocks (preferably pillow basalt margisn) from a single location and put in microbiobox
Collect corals (large for Tom, small for Amy)
Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore location)
Collect crabs and pinchbugs if seen

Special Equipment

1 extra long milk crate for corals (and crabs)
2 long milk crates for
rocks
Micorbiobox (trigger tracer syringe after box is closed)
Bacobox
Push cores (3)
Niskin bottles(5)

Collections

7 rocks (6 volcanic, 1 Mn crust)
5 small corals of same species
2 niskin water samples
2 large coral samples (same species)
1 Stalk containing barnacles
~6 samples of basalt for microbiobox

Dive plan for	Alvin Dive #	**3805**
Date	7/6/02	Saturday
Time	Start Dive	8:00
	End Dive	17:00
Location	Murray Seamount	

	Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position	~1950	54	1.17	148	30.86
End Position	~1100	53	59.64	148	30.86
Distance	2.85km				

Near vertical climb with one small saddle towards the end of the dive.
Would like to move horizontally along contours when samples look promising.

Personnel	Pilot	Pat Hickey
	Port Observer	Chris Moy
	Stbd Observer	Martin Fisk

Objectives
- Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)
- Collect rocks from many depths for geology (avoid rocks lying loose on surface)
- Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox
- Pushcores (1 at each sedimented location)
- Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations)
- Collect crabs and pinchbugs if seen

Special Eqpt
- Large crate for corals (and crabs)
- 1 large milk crate for rocks
- Microbiobox (open, fill with rocks, close, trigger tracer syringe)
- Push cores (3)
- Niskin bottles (5)

Samples collected
- 7 rocks (5 volcanic, 2 erratic)

Dive plan for	Alvin Dive #	**3806**	
Date	7/10/02	Wednesday	Bottom time
Time	Start Dive	8:00	8:32:00
	End Dive	17:00	1:23 PM

Location: Warwick Seamount
expected depth range: <1000 meters

	Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position	871	47.00889		131.1596	
End Position	803	48.09013		131.1596	
Distance	~1 km	mostly in east-west direction			

Navigation problems; very little distance vertically covered; conclusion: we were going around in circles
Started steep and became flat; position was in question

Personnel	Pilot	Bruce Strickrott
	Port Observer	Rob Dunbar
	Stbd Observer	Zachary Hoyt

Objectives
- Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)
- Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.
- Collect assorted crabs - tasty ones are preferred
- Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox
- Collect a few rocks if possible
- Collect a small (6-inch) piece of many individuals of the same species of coral
- Pushcores (1 at each sedimented location)
- Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals multiple bottles at once to get enough POC for analyses

Special Eqpt
- Crab basket
- Bacobox
- Microbiobox (open, fill with rocks, close, trigger tracer syringe)
- Small milk crate for rocks
- Push cores (3)
- Niskin bottles (5)

Samples collected	Crabs:	2 Chionocetes tanneri
		2 Galatheids
	Rocks:	1 for microbiology

	Corals:	4 bamboos (1 sub-fossil)
		2 Paragorgia
		4 Gorgonian fan corals
	Water:	4 Niskins
	Other:	1 transparent cucumber
Observations:	Area of dive was dominated by communities of large sponges >1 m in size, large Paragorgia and bamboo corals. Many Galatheids were common on corals both Paragorgia and bamboo. Common smaller white sea-fans (?, primnoid?) were observed as well as large sea anemones (up to 15 cm). Substrate consisted exclusively of basaltic flow material, mostly weathered pillows.	

Dive plan for Alvin Dive # **3807**

Date	7/11/02	Thursday
Time	Start Dive	8:00
	End Dive	17:00
Location	Warwick Seamount	

	Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position	2609	48	5.00	132	39.20
End Position	1390	48	4.39	132	41.03
Distance	2.55 km				
Bearing	244°				

Personnel	Pilot	Pat Hickey
	Port Observer	Martin Fisk
	PIT	Brian Leach

Objectives

Locate elevator, close lid, trigger release
Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox
Collect rocks from many depths for geology
Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)
Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.
Collect assorted crabs - tasty ones are preferred
Collect a small (6-inch) piece of many individuals of the same species of coral
Pushcores (1 at each sedimented location)
Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals, multiple bottles at once to get enough POC for analyses

Special Eqpt

1 extra long milk crate for corals (and crabs)
Microbiobox (open, fill with rocks, close, trigger tracer syringe)
2 large and 2 small milk crates for rocks
Push cores (3)
Niskin bottles (5)

Samples collected
Released crab trap.

Rock samples

	Time stamp	X	Y	Zm	Bin#
Sample #1	17:34	25437	18347	2467	6
Sample #2	18:00	25074 ?		2288	5
Sample #3	18:43	24707	17958	2091	4
Sample #4	18:53	24649	17927	2055	1
Sample #5	19:00	24612	17912	2027	Biobox
Sample #6	19:02	24612	17912	2027	2
Sample #7	19:40	24495	17855	1919	3
Sample #8	20:02	24464	17844		10
Sample #9	20:24	24352	17822	1706	7
Sample #10	20:31	24282	17787	1653	12
Portside Niskin: btl #5	16:44				
Second Niskin: btl #4	17:04				
Btls 3,2, &1	20:35				
Push cores	16:45			2575	
same nominal location	17:10			2581	

Dive plan for	Alvin Dive #	**3808**
Date	7/12/02	Friday
Time	Start Dive	8:00
	End Dive	17:00
Location	Warwick Seamount	

	Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position	~775m	48	3.44	132	44.37
End Position	~550m	48	3.44	132	45.86

Distance 2km
Bearing Due West

A shallow climb up from a flat ledge off Warwick. Can zig-zag along contours to find critters/rocks. Approx. end position - not a race to get to the end position. Can go further if so choose as well.

Personnel	Pilot	Phil Forte
	Port Observer	Tom Guilderson
	PIT	Chris Russo

Objectives
- Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox
- Collect rocks from many depths for geology
- Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)
- Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.
- Collect assorted crabs - tasty ones are preferred
- Pushcores (1 at each sedimented location)
- Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals, multiple bottles at once to get enough POC for analyses

Special Eqpt
- Crab/coral pot
- Microbiobox (open, fill with rocks, close, trigger tracer syringe)
- 2 milk crates for rocks (large and small)
- Push cores (3)
- Niskin bottles (5)

Samples collected 5 rocks (all volcanic)

OBSERVER NOTES:

Released to bottom ~1500GMT		200m	1510	6.4C
		630m	1524	4.2C
bottom	15:30	760		

sm bamboo, pipe cleaners, anenomes, sm rubbery pink coral, one smallish rattail and Sebastes (red), several small crabs and pinch bugs
bottom consists of a solid MnO crust with a dusting of sediment

will spl small to mid bamboo just to port - few fronds for ABT and rest into crab-pot
Niskin - first from port (#5) 19471 15576 (via Bruce)
19059 15169 overlay
Sm bamboo #1 16:02 758m 3.8C ABT #9
Nav computer acting stupid…. Why the heck would anybody want to run software on a windows box??
reset 2XX, overlay updated 16:23h
We are 60m due south of target
Climbing ~16:25 slight current from south
sm. Black corals 753m 16:27h to port (where are the brittle stars?)
scattered biology, larger sponges
~743m Tanner crab to portside - saw it too late to stop, also some small scarlets(?)
Current picked up like crazy - or did we loose a weight?
back to bottom ~768m 16:52h
Bamboo #2 17:03 19388 15681 larger, good solid thunk coming out
sm reddish coral in crab pot (w/o rock) 19388 15681
Nice wall w/ lots of bio to 726m
Dike below us 17:30
2-rocks spls into bins # 1&2 forward @ 17:42 19226 15640 725 samples 1 & 2
3-chip pan and zoom
Changed DV-CAM tape ~17:57
Bamboo #3 ~17:57 19210 15689 720
2nd niskin port (#4) ~17:57 19210 15689 720
red sea whippy thing on rock
rubble field 715-690m & current much less (finally!!)
Bamboo #4 19155 15581 705 (1 x 1 m) ABT #10 (aft jar)
It is painful to watch Phil prune this to fit in the crab pot.
Scarlet kings - off to port, medium sized but multiples of them. 18:49h 695m
Rock sample #3 19:09 19038 15573 658 bin #3 (port aft of 4-bin box)
taken from a large outcrop of a highly fractured but massive (~2 m wide) lava flow
less MnO crust and more sediment present at depths above the rubble field (~670 m)
Biogeo box - lava tube- rock sample #4 19020 15573 646
samples aquired from both the interior and margin area of a large lava tube in hopes of biological mediated glass margin
Space check - 2 more rocks, 3 niskins, more coral (19:50 hr, ~1 hr bottom time)
Interesting - no gold coral only small black corals - nothing worth grabbing
Bamboo #5 18979 15577 634 (4C) pieces into ABT bins on starboard, both bins
Last 3-niskins fired here before sampling (3-2-1)
This bamboo is incredible !!! 1.5m x 1.5m superstructure (at least) and 40 cm up from stalk. Lots of p/t and 3-chip
octopus to port 2 foot arm-length (via Phil) 18877 15566 617
All three push cores from this small enclave - nice foram sand !!!!
Final rock sample #5 21:00 18884 15569 617
sample acquired near the margin of another massive lava flow, the interior of the flow is characterized by large columnar jointed basalt (columns ~1m in length and well defined

Dive plan for	Alvin Dive #	**3809**				
Date	7/13/02	Saturday				
Time	Start Dive	8:00				
	End Dive	17:00				
Location	Warwick Seamount					
		Depth (m)	Lat deg	Lat min	Lon deg	Lon min
Start Position		~1300	48	5.51	132	44.81
End Position			48	4.43	132	45.41
Distance	2.1 km					
Bearing	S S/W					

A steep climb from a small ledge at mid-depth.
Release crab-trap elevator
Can go further if so choose as well.

Personnel	Pilot	Bruce Strickrott
	Port Observer	Brendan Roark
	PIT	Chris Russo

Objectives
- Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox
- Collect rocks from many depths for geology
- Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)
- Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.
- Pushcores (1 at each sedimented location)
- Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals, multiple bottles at once to get enough POC for analyses

Special Eqpt
- Crab/coral pot
- Microbiobox (open, fill with rocks, close, trigger tracer syringe)
- 2 milk crates for rocks (large and small)
- Push cores (3)
- Niskin bottles (5)

OBSERVER NOTES:

Samples collected	time	x	y	depth
released to bottom @ ~15:00 GMT				
on bottom	15:49	19056	19276	1200

visible at bottom are a few scattered small black and "pipe cleaner" corals, some red "spine back" fish
and rattail fish, and a couple of shrimp swimming in the water column
bottom is very flat and covered with a few inches of sediment
began looking for crab trap 16:07

crab trap found	16:19	18950	19404	1210
upon arrival two crabs were spotted in the trap and a couple more were on the ground in the near vicinity of the trap.				
crab trap released acoustically	16:35			
1 crab in the trap				
computer crash and rebooted	16:41			
sediment core taken near trap locale	16:45	18950	19404	
niskin bottle #1 fired				
sedimented area around crab trap has lots of rattail fish spread out a few meters apart				
terrane change	17:02	18853	19104	1194
sediment covered ground ends abrubtly at the base of a large outcrop of pillow basalt				
Rock sample #1	17:06	18854	19096	1191
sample taken from a large pillow basalt in the outcrop placed into bin position #1 close-up video of sampling also acquired.				
Rock sample #2	17:14	18865	19099	1184
sample collected from the margin of a weathered out pillow basalt and placed into the crab box				
climbing up from the pillow outcrop we came across some MnO oxide plates before returning to flat sedimented terrane		18860	19051	1169
moving along this sedimented area we reached a second outcropping of pillow basalt				
terrane change		18846	18981	1155
Rock sample #3 (biobox)	17:30	18865	18985	1148
two pieces from a large pillow basalt were collected one placed in the biobox and the other into bin#4				
terrane flattened out again	18:05			1130
more "life" present lots of pinch bugs and sponges along with anemones				
terrane change				1100
flat area ended at the base of another massive pillow basalt outcrop. This outcrop also has a lot of flow toes draped over and in between pillow basalts.				
Crab sampled	18:07	18882	18916	1093
terrane change	18:17	18901	18710	
flat area covered with rubble and lightly sedimented				
computer crash	18:20			
computers reset by Bruce				
terrane change	18:24	18895	18641	1088
another pillow basalt outcrop				
terrane change	18:27	18873	18611	1084
"pavement" like terrane with a moderate slope				
terrane change	18:35	18834	18505	1040
back to pillow basalts				
attempted to sample pillow basalt	18:40	18831	18489	1020
sample could not be obtained on account of strong currents				
terrane change				1012
pillow basalts overlain by more massive flows				
terrane change	18:49	18820	18479	995
back to more pillow basalt currents still strong				

terrane change, back to more massive basalt flows				980
Rock sample #4	18:55	18818	18475	977
large basalt piece removed from near the margin of a basalt flow				
terrane change		18812	18445	973
top of the outcrop was reached and terrane flattened out became "pavement" like and was slightly sedimented.				
terrane change	19:13	18786	18383	963
pavement like terrane becam covered by rubble				
bus tye fuse failure	19:30	18787	18217	935
failure leads to end of dive				
final 4 niskin bottles fired	19:34	18790	18220	935